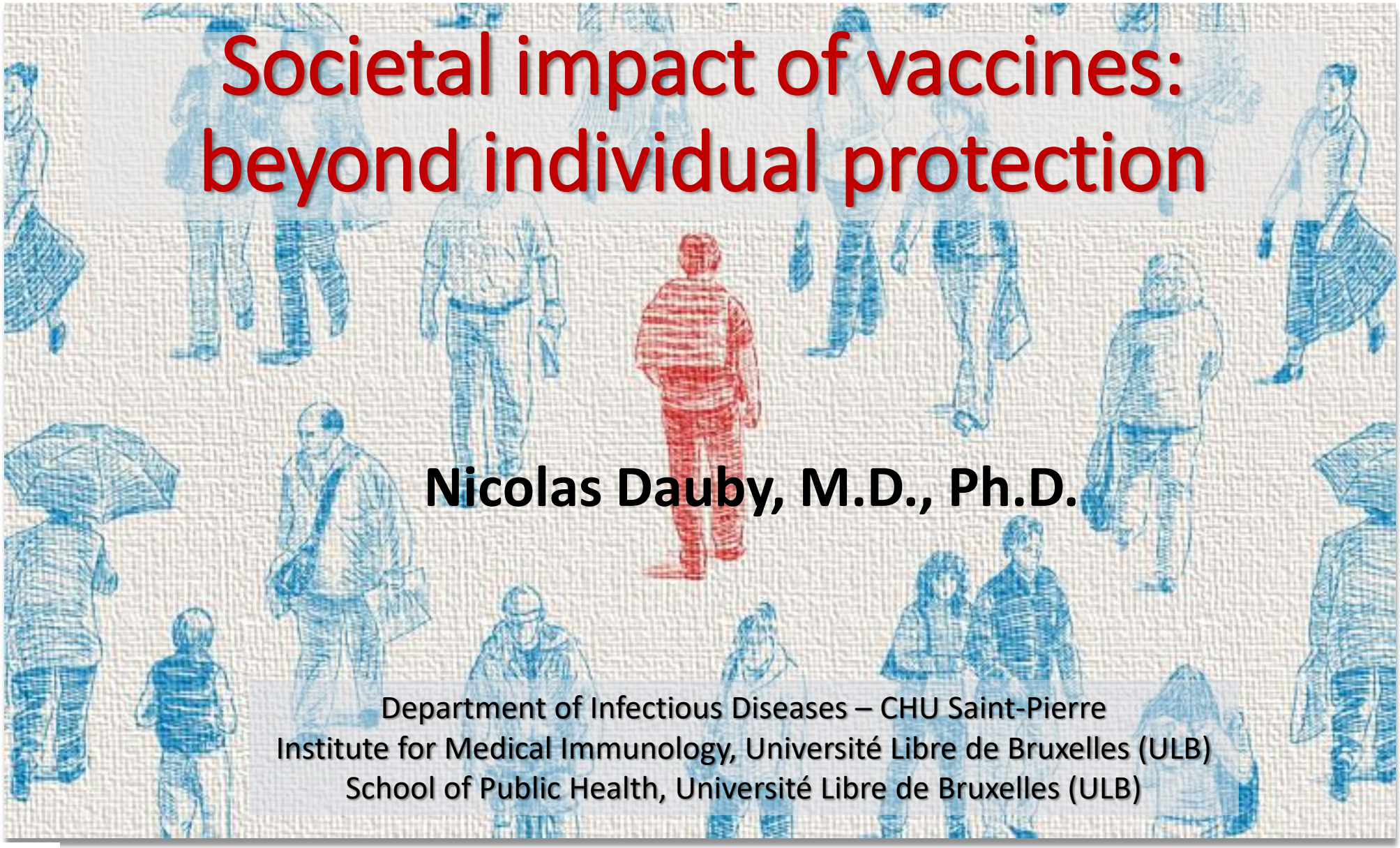
Societal impact of vaccines: beyond individual protection



Nicolas Dauby, M.D., Ph.D.

Department of Infectious Diseases – CHU Saint-Pierre
Institute for Medical Immunology, Université Libre de Bruxelles (ULB)
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ULB UNIVERSITÉ LIBRE DE BRUXELLES

CHU Saint-Pierre
UMC Sint-Pieter

fnrs LA LIBERTÉ DE CHERCHER

Institute for Medical Immunology

esp

Conflict of interest

I am not a consultant for pharmaceutical companies

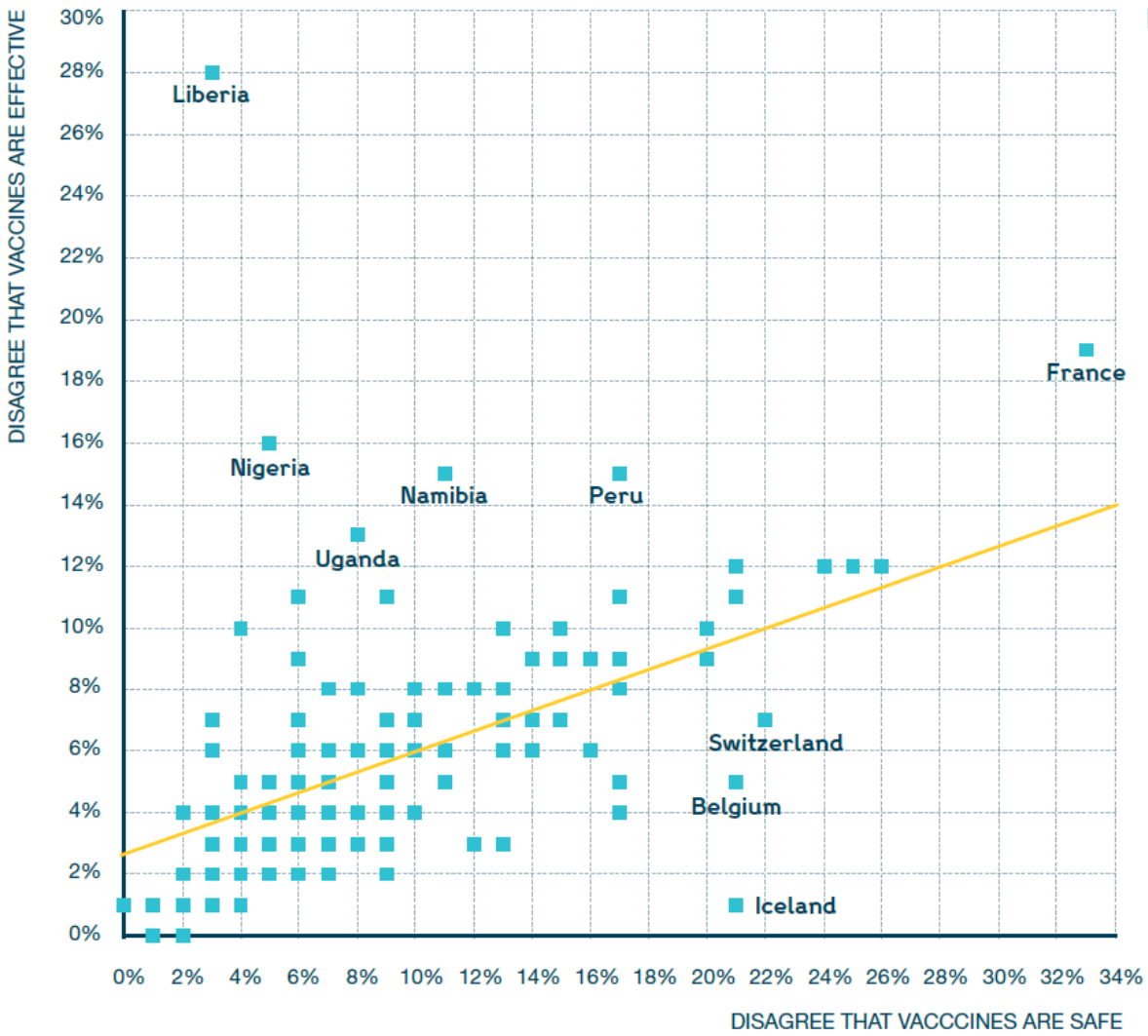
I am leading a study about Boostrix ® immunization – this study is not financed by the industry.

I have received non-financial support from pharmaceutical companies to attend scientific conferences (Pfizer, Jannsens & MSD) with the aim to increase my scientific knowledge and patient care. This support was in accordance with the Belgian Law.

Vaccine hesitancy (WHO)

- Top ten health threats to the world in 2019

- « Delay in acceptance or refusal of vaccines despite the availability of vaccination service »


DISAGREE THAT VACCINES ARE EFFECTIVE
30%
28%
26%
24%
22%
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
Liberia
Nigeria
Namibia
Peru
Uganda
France
Switzerland
Belgium
Iceland
0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20% 22% 24% 26% 28% 30% 32% 34%
DISAGREE THAT VACCCINES ARE SAFE
Country
Trend

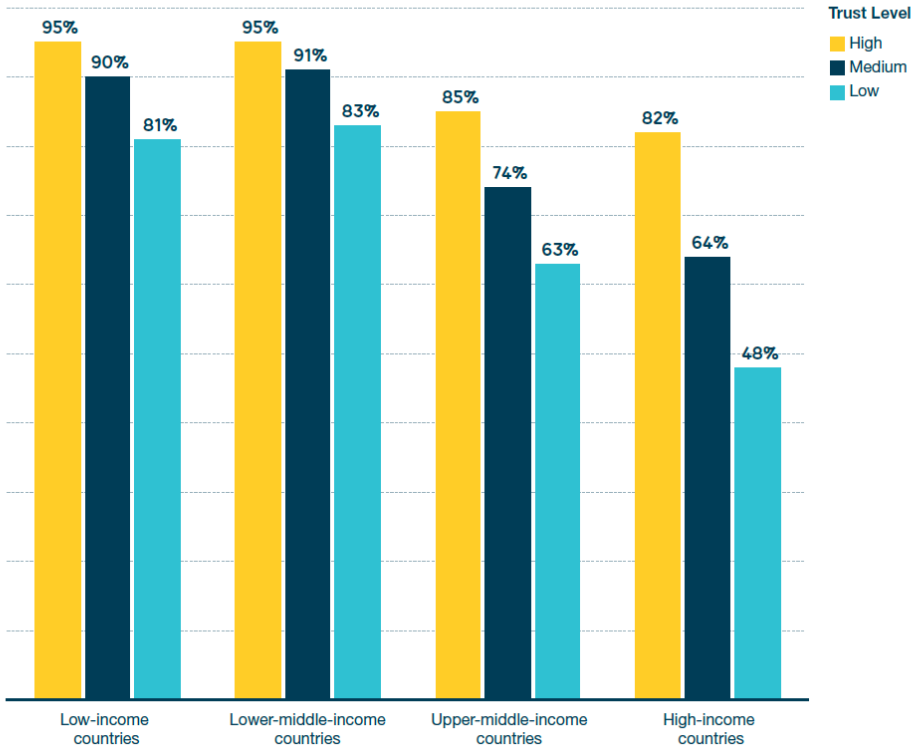

WORLD CUP FINAL

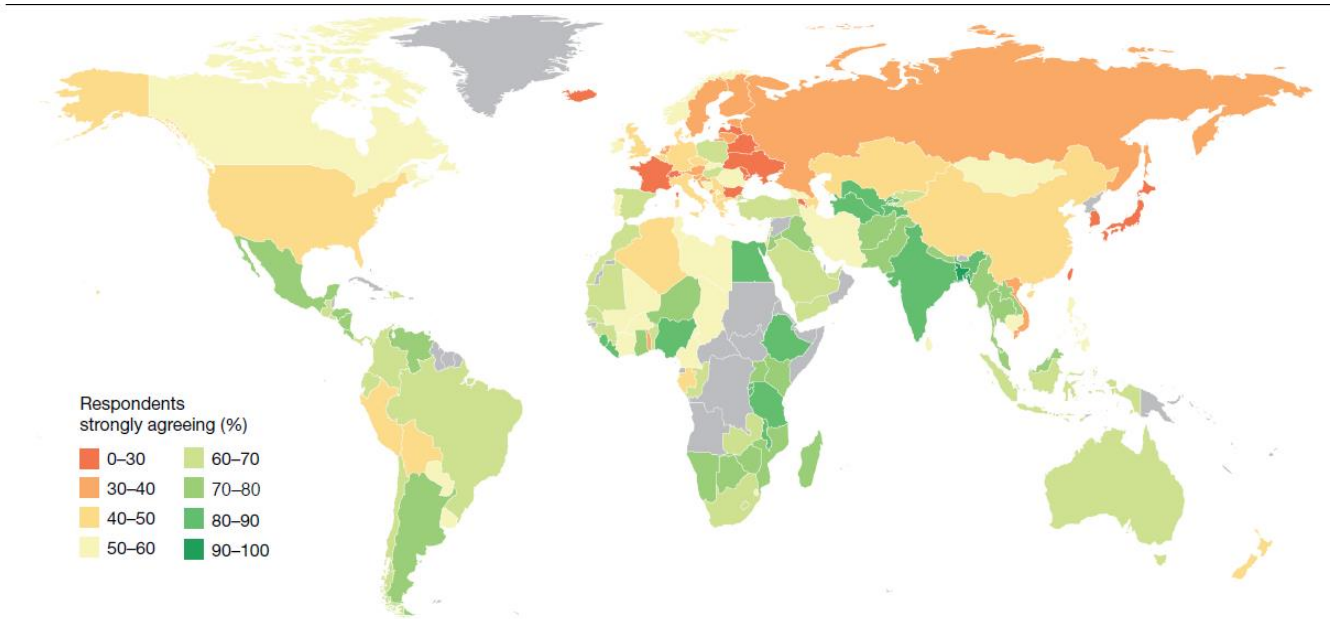
wellcome

Perceived safety of vaccines by level of Trust in Scientists Index among countries of different income levels

Do you agree, disagree, or neither agree nor disagree with the following statement?

Vaccines are safe.

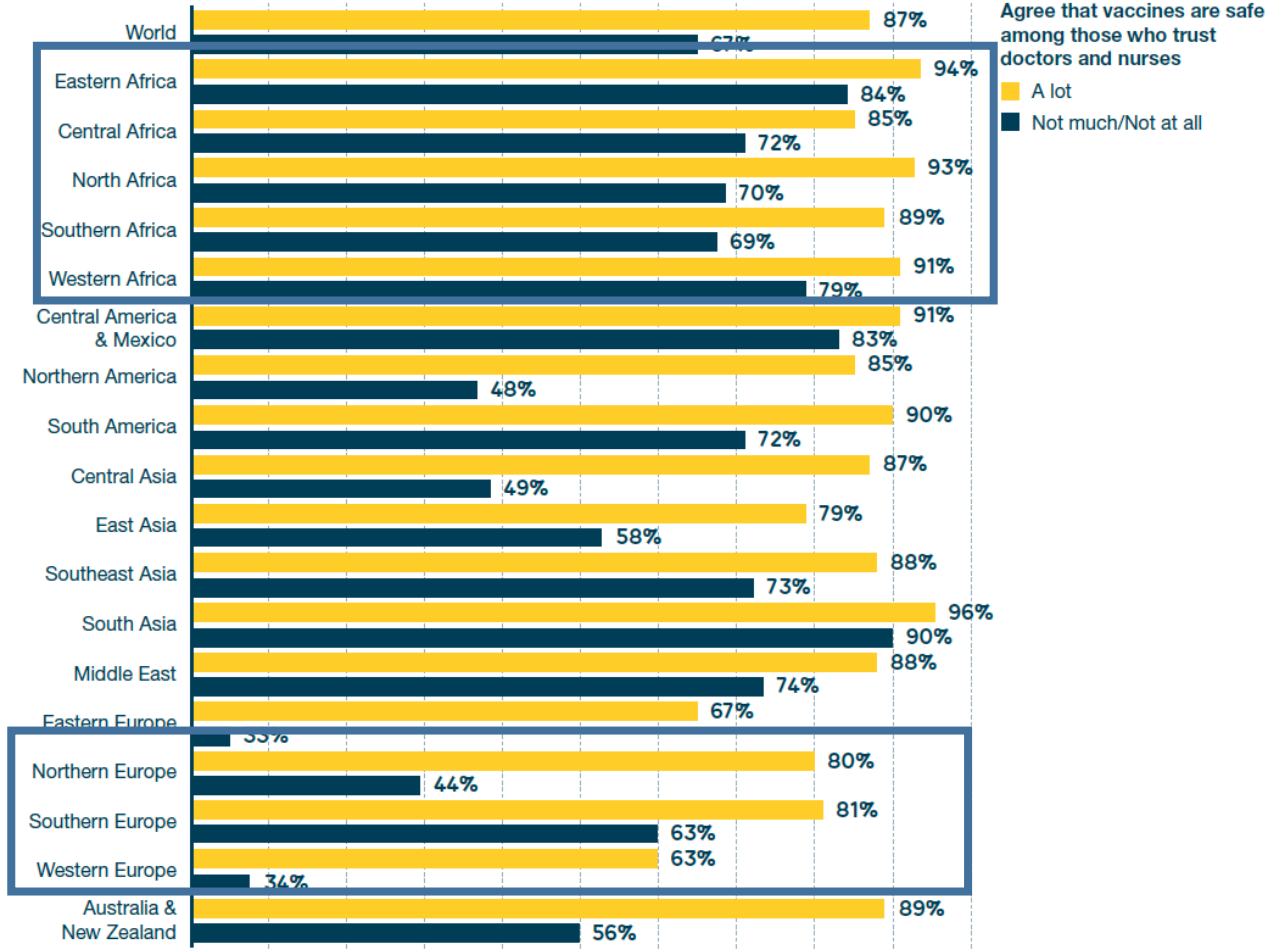




Piot et al et *Nature* 2019

Perceived safety of vaccines by level of trust in doctors and nurses and by region

People with a high trust in doctors or nurses are very likely to say vaccines are safe.



Recommandations of the SAGE working group on vaccine hesistancy

To WHO:

b) **Engage partners, including civil society organizations, at the global, regional and country levels, to mobilize in support of immunization**, its benefits to individuals and for communities.

To member states :

d) Ensure **education on vaccination** and immunization in general, and addressing vaccine hesitant patients in particular, by inclusion relevant training into academic curricula of nursing, medical and other health care professional students.

e) Ensuring **education and knowledge about vaccines in younger individuals** provides a good opportunity to further shape future vaccine beliefs and behaviour.

SAGE Report 2014

Societal impact of vaccines

1. Concepts : Narrow vs broad benefits of vaccination
2. Evidences from developping countries
3. Evidences from developped countries
4. Vaccination improves gender inequalities
5. Vaccination & antimicrobial resistance

Societal impact of vaccines

1. **Concepts : Narrow vs broad benefits of vaccination**
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Economic analyses of vaccine policies

Cost-effectiveness analysis :

- Most widely used tool for economic evaluation of vaccination
- Measured in Quality-adjusted life years (QALYs)
- Allows prioritization of health interventions

Benefit-cost analysis:

- Quantify the cost of an intervention and the monetary benefits
- Value of health in facilitating non-health aspects

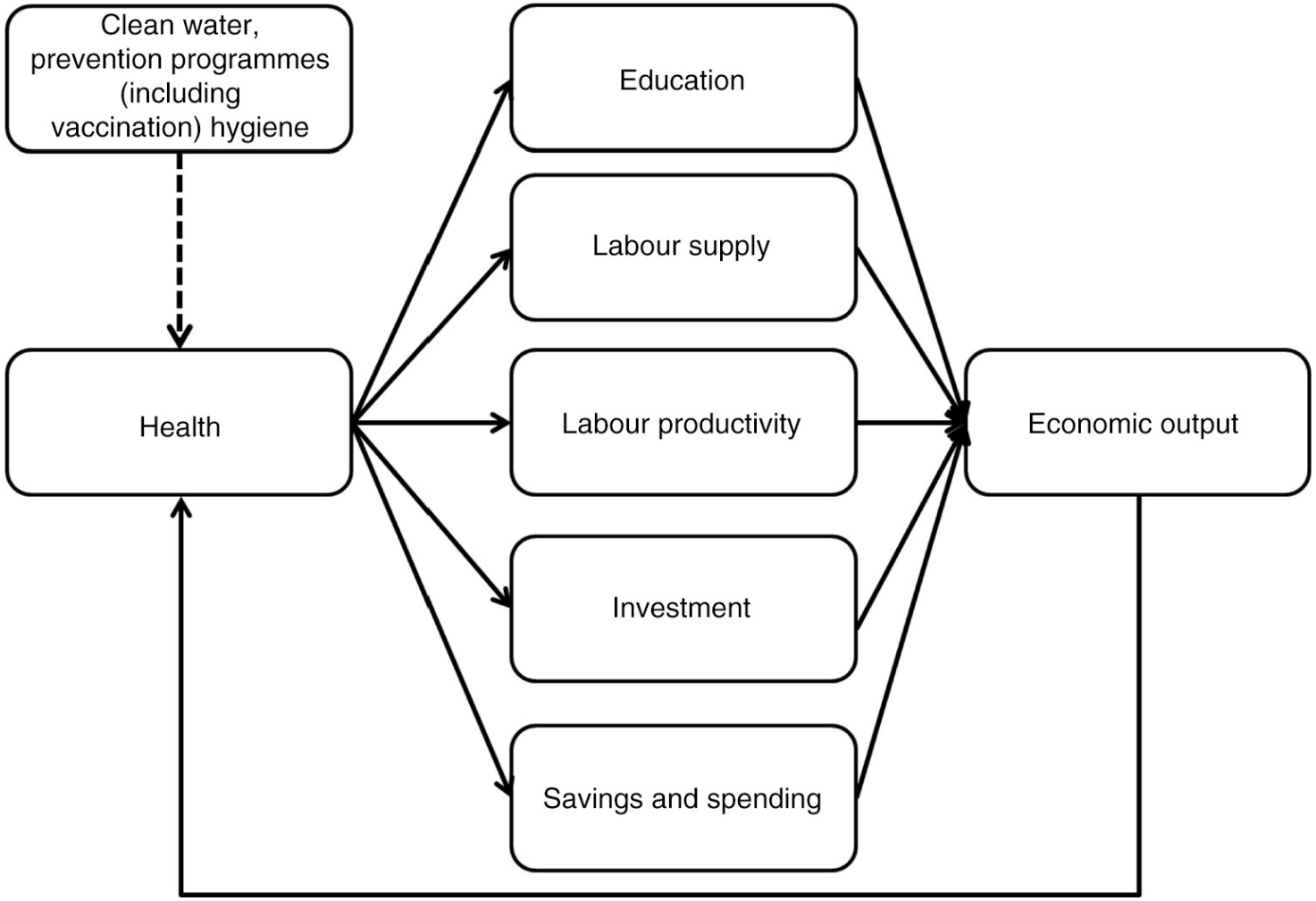
Bloom *Sci. Transl. Med* 2018
Miller & Gessner *Vaccines* 7th edition

Cost effectiveness analysis

Intervention	Median cost/QALY (US$)
Vaccination	1500
Pharmaceuticals for aymptomatic persons (e.g. hormone replacement)	13000
Screening test for CV diseases	3300
Screening test for neoplasms	18500

Miller & Gessner *Vaccine* 7th edition

Link between health and economic output



Quilici *J Market Access & Health Policy* 2015

A broader perspective for economic evaluations of vaccination

Perspective	Benefit categories	Definition
Narrow	Health gains	Reduction in morbidity & mortality
	Healthcare cost savings	Savings of medical expenditure
	Care-related productivity gains	Saving of patient's and caretaker's productive time

Barninghausen *CMI* 2012

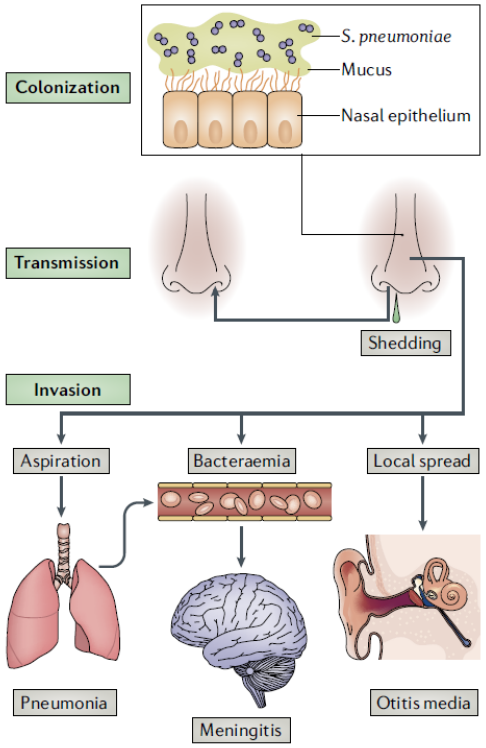
A broader perspective for economic evaluations of vaccination

Perspective	Benefit categories	Definition
Narrow	Health gains	Reduction in morbidity & mortality
	Healthcare cost savings	Savings of medical expenditure
	Care-related productivity gains	Saving of patient's and caretaker's productive time
Broad	Outcome-related productivity gains	Increased productivity because vaccination improve physical & mental health
	Behaviour-related productivity gains	Better health and survival changes individual behaviour (lower fertility, investment in education)
	Externalities	Improved outcome in unvaccinated community members (herd effect, decrease antibiotic resistance)

Barninghausen *CMI* 2012

Broad view of vaccine benefits : PCV

Vaccination	Health outcomes targeted	Benefits	Examples
PCV	Pneumococcal diseases, including pneumonia, meningitis, and otitis media	Outcome-related productivity gains	Episodes of pneumococcal pneumonia will keep children out of school, impeding cognitive development and learning (19, 22). Survivors of pneumococcal meningitis can suffer from severe cognitive and neurological sequelae (19, 23). Pneumococcal otitis media can impair cognitive development and lead to hearing loss (19, 26, 35).
		Community health externalities	PCV coverage decreases the use of antibiotics and thus the rate of occurrence of antibiotic-resistant pneumococcal infections (19, 49). Herd effects: Childhood PCV vaccination is likely to lead to substantial reduction in pneumococcal disease in population groups that will not routinely receive the vaccination, because it prevents the spread of the infection to these groups, e.g., the elderly and HIV-infected middle-aged adults (19, 46). Evidence from studies of PCV7 and PCV10 introduction indicate reduced circulation of vaccine-specific serotypes in the population (42–44).

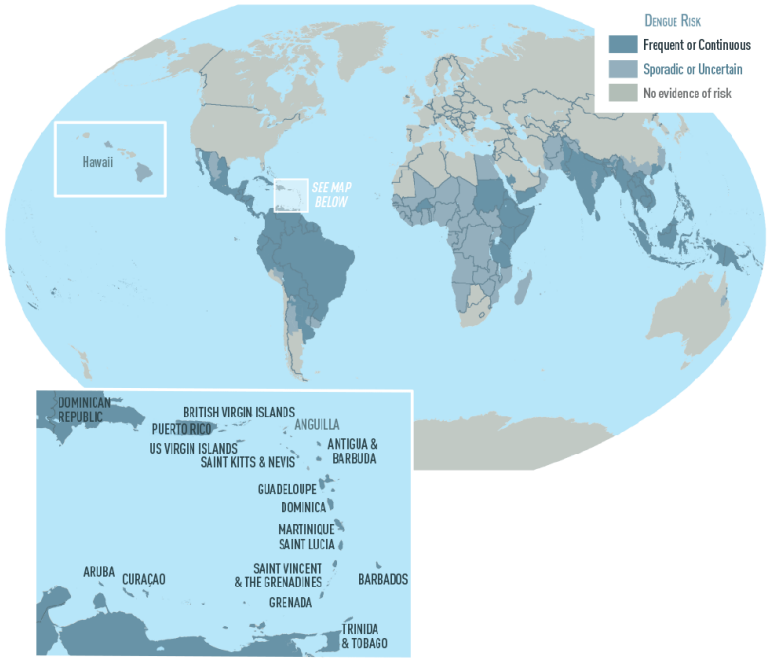


Bärnighausen et al *PNAS* 2014
Weiser *Nat Rev Microbiol* 2018

Broad view of vaccine benefits : Dengue

Vaccination	Health outcomes targeted	Benefits	Examples
Dengue vaccine (prospective)	Dengue fever, severe dengue	Outcome-related productivity gains	Persistent symptoms following the acute phase of dengue infect which can include prolonged fatigue, muscle and joint pain, weakness, and depressive symptoms, could affect labor productivity (20, 34, 58, 59).
		Community health externalities	Unvaccinated community members could benefit from reduced dengue transmission between human hosts and the dengue mosquito vector (20).
		Community economic externalities	Health improvements resulting from dengue vaccination could make an economy more attractive for foreign direct investment and tourism (20). Reductions in dengue incidence could reduce public and private spending on outbreak control; these monies can be invested elsewhere stimulating economic growth (20).

Infection Contained



Bärnighausen et al *PNAS* 2014

CDC Map

Societal impact of vaccines

1. Concepts : Narrow vs broad benefits of vaccination
2. **Evidences from developping countries**
3. Evidences from developped countries
4. Vaccination improves gender inequalities
5. Vaccination & antimicrobial resistance

Estimated economic impact of vaccinations in 73 low- and middle-income countries, 2001–2020

Sachiko Ozawa,[a] Samantha Clark,[b] Allison Portnoy,[c] Simrun Grewal,[d] Meghan L Stack,[e] Anushua Sinha,[f] Andrew Mirelman,[g] Heather Franklin,[f] Ingrid K Friberg,[h] Yvonne Tam,[b] Neff Walker,[b] Andrew Clark,[i] Matthew Ferrari,[j] Chutima Suraratdecha,[k] Steven Sweet,[l] Sue J Goldie,[l] Tini Garske,[m] Michelle Li,[n] Peter M Hansen,[o] Hope L Johnson[n] & Damian Walker[p]

- 73 countries that received GAVI support since 2001
- Health and Economic impact of vaccination against 10 VPD
  - Routine immunizations (Hib, HBV, HPV, Rotavirus, *S. pneumoniae*)
  - Supplementary immunizations (JEV, measles, *N. meningitis*, rubella & YF)
- Decision tree models to capture **short and long term averted costs of illness**
- Five categories of costs
  1. Averted **treatment** costs
  2. Averted **transportation** costs for seeking care
  3. Averted reduction in **caregivers' economic output**
  4. Averted **loss of productivity** due to **premature death**
  5. Averted **loss of survivors'productivity** due to **disability**

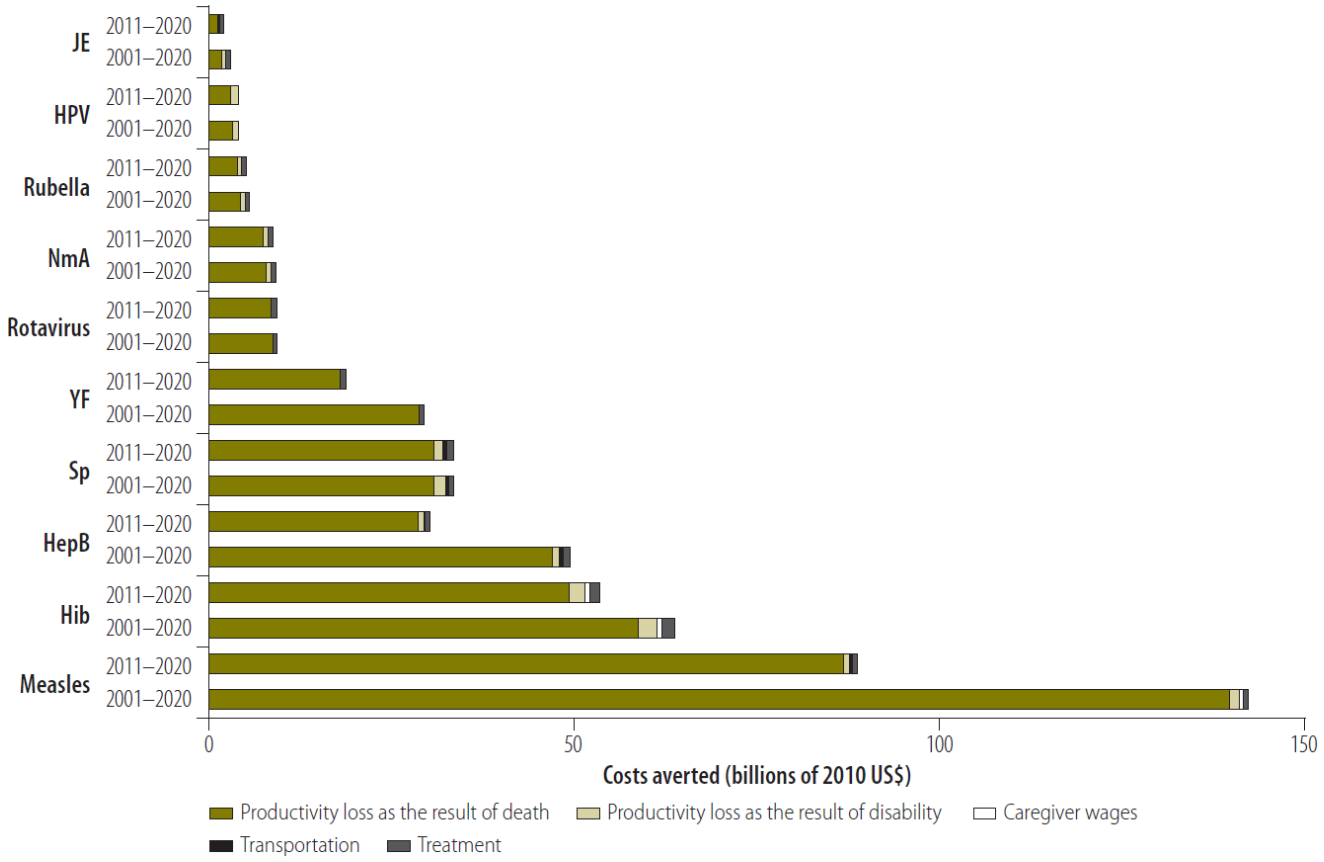
Bull World Health Organ 2017

Pathogen	Vaccines	Target disease	Death and disabilities adverted
Haemophilus influenzae type b	Pentavalent	Meningitis and pneumonia	Death, deafness, cognitive impairment, motor impairment and seizure disorder
Hepatitis B virus	Monovalent, tetravalent (DTP–HepB) or pentavalent (DTP–HepB–Hib)	Acute/fulminant infection, chronic infection, hepatocellular carcinoma, compensated and decompensated cirrhosis	Death
Human papillomavirus	Recombinant quadrivalent or bivalent	Cervical cancer	Death
Japanese encephalitis virus	Live attenuated	Japanese encephalitis	Death, neurological sequelae/cognitive impairment
Measles[a] virus	Live attenuated (measles or measles–rubella)	Measles	Death, central nervous system sequelae
Neisseria meningitidis serogroup A	Conjugate	Meningitis	Death, deafness, vision impairment, motor impairment and seizure disorder
Rotavirus	Attenuated oral rotavirus (RV1 or RV5)	Severe and non-severe diarrhoea	Death
Rubella virus	Live attenuated (rubella or measles–rubella)	Congenital rubella syndrome	Death, hearing loss, vision loss, cardiac abnormalities and central nervous system complications
Streptococcus pneumoniae	Conjugate (PCV10 or PCV13)	Meningitis and pneumonia	Death, deafness, cognitive impairment, motor impairment and seizure disorder
Yellow fever virus	Live attenuated (17D)	Yellow fever disease	Death

Table 3. **Costs of illness averted as the result of vaccinations against 10 diseases, 73 Gavi-supported low- and middle-income countries, 2001–2020**

Pathogen	Averted costs of illness (2010 US$)		
	Per vaccinated individual[a]	Per care-seeking case averted[b]	Per death averted[c]
Hepatitis B virus	61	12	7 000
Haemophilus influenzae type b	105	48	22 000
Human papillomavirus	102	7	4 000
Japanese encephalitis virus	9	200	35 000
Measles virus	85	7	27 000
Neisseria meningitidis serogroup A	25	31	17 000
Rotavirus	37	9	23 000
Rubella virus	5	71	16 000
Streptococcus pneumoniae	122	38	19 000
Yellow fever virus	72	10	19 000

Fig. 1. **Costs of illness averted as the result of vaccinations against 10 diseases, 73 Gavi-supported low- and middle-income countries, 2001–2020 and 2011–2020**



2001-2020 :

- **20 millions deaths**
- Cost of illness : **350 billions US$**
- Lifelong productivity gains for death & disability : **330 billions US$ and 9 billions US$**
- Broader economic value : **820 billion US$**

By Sachiko Ozawa, Samantha Clark, Allison Portnoy, Simrun Grewal, Logan Brenzel, and Damian G. Walker

Return On Investment From Childhood Immunization In Low- And Middle-Income Countries, 2011–20

Societal impact of vaccines

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Economic Evaluation of the Routine Childhood Immunization Program in the United States, 2009

AUTHORS: Fangjun Zhou, PhD,[a] Abigail Shefer, MD,[a] Jay Wenger, MD,[a] Mark Messonnier, PhD,[a] Li Yan Wang, MBA,[b] Adriana Lopez, MHS,[a] Matthew Moore, MD, MPH,[a] Trudy V. Murphy, MD,[b] Margaret Cortese, MD,[a] and Lance Rodewald, MD[a]

[a]National Center for Immunization and Respiratory Diseases, and [b]National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, Centers for Disease Control and Prevention, Atlanta, Georgia

- 4.261.494 birth cohort followed until death
- Direct costs
  - Medical (treatment of diseases & sequelae)
  - Non medical (travel costs, special needs for disabled children)
- Societal costs
  - Direct (outbreak control)
  - Indirect (productivity loss)
- Vaccine adverse effects

  -Example : HBV : $1/10^6$ children with anaphylaxis

- Decision tree for each pathogen

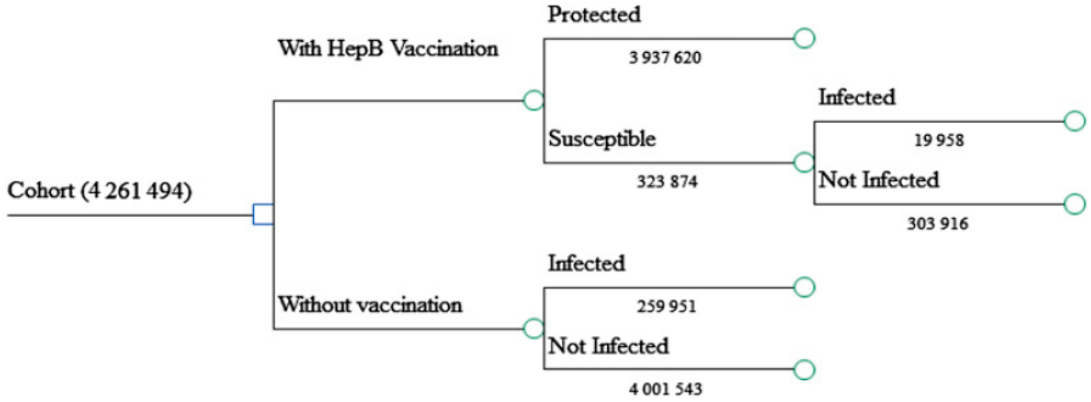


TABLE 1 Annual Incidence Rates of Diphtheria, Tetanus, Pertussis, Hib, Polio, Measles, Mumps, Rubella, HepB, Varicella, IPD, HepA, and Rota (per 100 000)[7,13–36,a]

Disease	Without Vaccination (ie, Pre-Vaccine Era)	With Vaccination (ie, data by 2009)
Diphtheria[b]	600	0
Tetanus[b]	0.3	0.003
Pertussis[b]	4720	12
Hib[c]	158	0.1
Polio, paralytic[b]	31	0
Measles[d]	10 641	0.2
Mumps[b]	6205	11.3
Rubella[b]	3300	0.01
HepB[e]	72.4	5.5
Varicella[e]	9839	394
IPD[c]	213.6	31.8
HepA[f]	14.3	2.5
Rota[g]	12 750	6209.1

TABLE 2 Probabilities and Costs of Hospitalizations and Outpatient Visits for Selected Vaccine-Preventable Diseases (All Costs Are in 2009 USD)[18–21,34–36,45,46,48,59–65,a]

Disease	Probability of Hospitalization, %	No. of Hospitalization Days	Cost per Hospitalization, $	Cost per Outpatient Visit, $
Diphtheria	100	6.1	15 004	88
Tetanus	100	16.7	90 635	88
Pertussis	0.65–30	5.5–15	9511–19 800	88–153
Hib				
Acute cases	50–100	2–7.29	3632–33 812	88–312
Sequelae among meningitis cases	5–30	2.84–26.75	16 076–43 501	274–504
Poliomyelitis	5–100	4–17	6875–44 665	88
Measles	11–100	1.3–10.9	3562–40 695	78–465
Mumps	1–100	2.8–8.7	9892–40 695	97–491
Rubella	0.1–100	2.6–8.7	4317–40 695	79–575
Congenital rubella syndrome				
Hospitalization for investigation	100	13.6	54 984	97
Heart surgery	100	8.9	32 763	
Cataract surgery	100	2.2	7763	
HepB	0.001–100	3.9–11	13 838–23 900	189–529
Varicella	0.1–2.1	3.1–9.3	3654–19 537	73–224
Pneumococcal diseases	0–100	6.4–16.8	3356–22 837	76–240
HepA	0–100	2–11	11 070–33 064	98–1185
Rota	0.5–3.8	2–3.4	2823–4235	119–402

TABLE 3 Estimated Cases and Deaths Prevented and Costs Saved for Selected Vaccine-Preventable Diseases With a Vaccination Program for 1 Cohort[a]

Disease	Cases Prevented	Deaths Prevented	Direct Costs Saved, Million $	Societal Costs Saved (Direct + Indirect), Million $
Diphtheria	275 028	27 503	3654	39 296
Tetanus	169	25	12	45
Pertussis	2 950 836	1062	4443	7017
Hib	19 606	741	1810	3756
Polio	67 463	800	2898	7259
Measles	3 835 825	3106	3762	8862
Mumps	2 312 275	12	1411	2374
Rubella	1 981 066	15	187	721
Congenital rubella syndrome	632	70	133	257
HepB	239 993	3514	240	1770
Varicella	3 942 546	73	373	1598
HepA	153 164	36	52	114
Pneumococcus-related diseases[b]	2 323 952	5056	965	2696
Rota	1 582 940	19	327	595
Total	19 685 495	42 032	20 267	76 360

~20 milions cases of diseases prevented

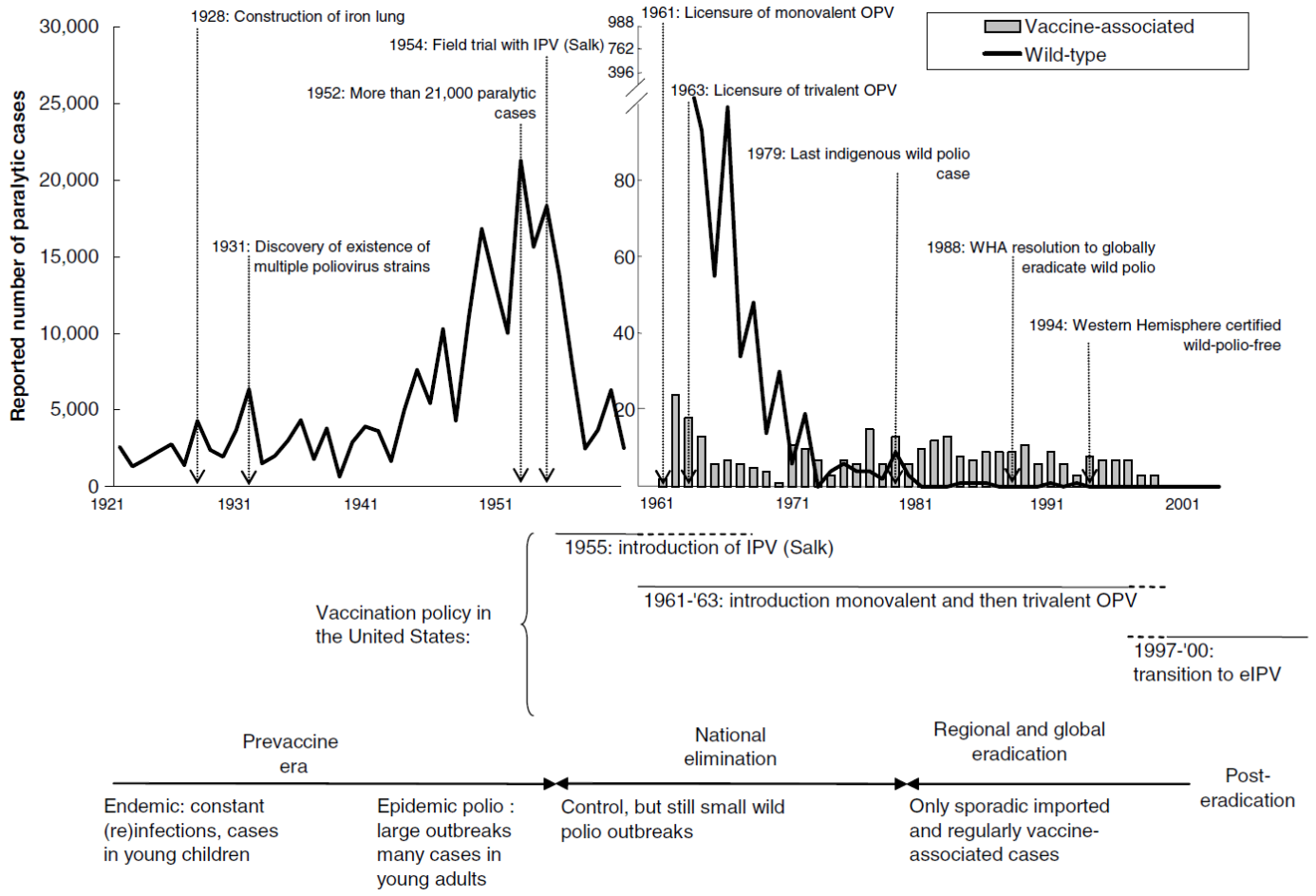
42.032 deaths prevented

Direct costs saved : 20 267 millions $; Societal costs saved : 76 360 millions $

Risk Analysis, Vol. 26, No. 6, 2006 DOI: 10.1111/j.1539-6924.2006.00831.x

Retrospective Cost-Effectiveness Analyses for Polio Vaccination in the United States

Kimberly M. Thompson[1,2*] and Radboud J. Duintjer Tebbens[1,3]



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Retrospective Cost-Effectiveness Analyses for Polio Vaccination in the United States

Kimberly M. Thompson[1,2*] and Radboud J. Duintjer Tebbens[1,3]

US :

- Investment of $35 billion (1955 net present value) in polio vaccine between 1955-2005
- Investment of $1.4 billion between 2006-2015
- Prevention of
  - 1.1 million cases of paralytic polio
  - 160.000 deaths
- Treatment cost savings : **benefits of $180 billion** (1955 net present value) after substraction of the vaccine costs

The fiscal consequences of Adult immunisation in The Netherlands

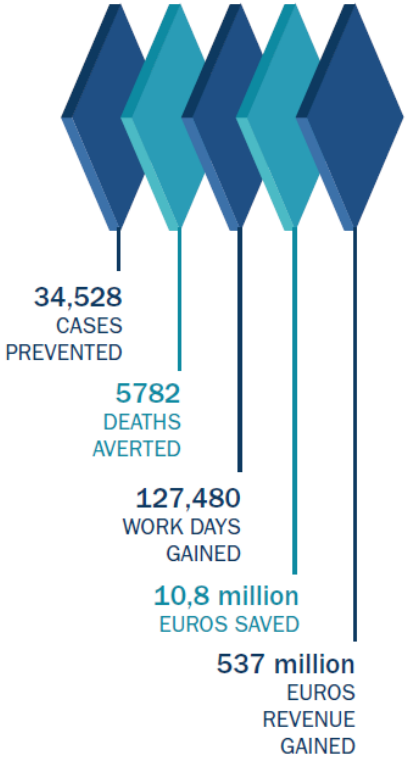
- Vaccination of adults > 50 years for 7 VPD :
  - *Streptococcus pneumoniae*, TT, DT, Pertussis, annual influenza, HZV

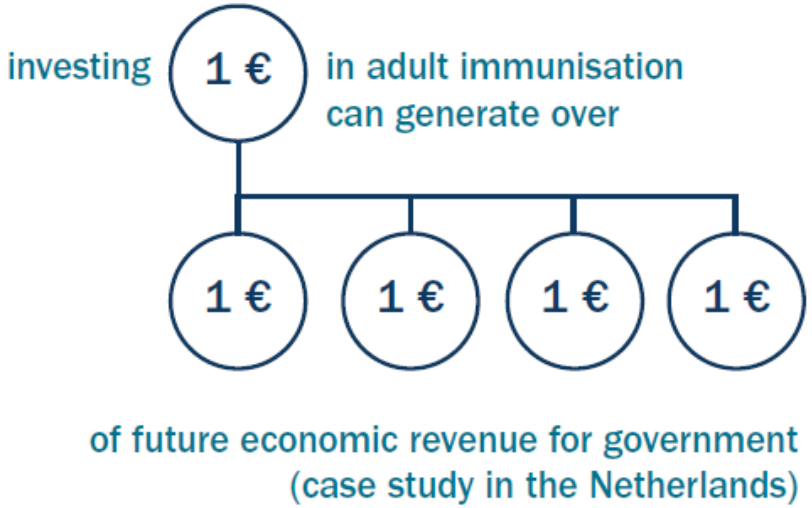
- Model takes into account
  - Transfers to Government (income tax, VAT, social insurance)
  - Transfers from Governement (social services, pension, healthcare expenses)
  - Retirement at 67 years
- Comparison of vaccinated & non vaccinated cohorts

SAATI report 2013

The fiscal consequences of Adult immunisation in The Netherlands

- Cost for vaccinating a cohort of individuals in 2012 + annual influenza: 136 millions euros





SAATI report 2013

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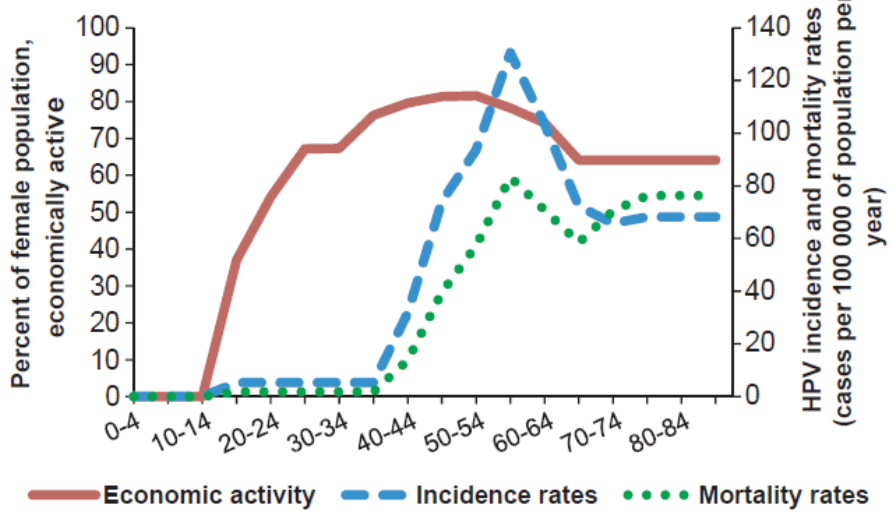
HPV vaccination & women health

- HPV vaccine prevent 90% of cervical cancer cases
- Majority of HPV cancer occurs in developing countries
- HPV incidence and mortality highest when the women are economically active
- HPV impacts household behaviours



Barnighausen *CMI* 2012

Available online at www.sciencedirect.com
ScienceDirect
Gynecologic Oncology 105 (2007) 335–340
Gynecologic Oncology
www.elsevier.com/locate/ygyno

The socio-economic impact of cervical cancer on patients and their families in Argentina, and its influence on radiotherapy compliance. Results from a cross-sectional study

Silvina Arrossi [a,*], Elena Matos [b], Nicolas Zengarini [b], Berta Roth [b], Rengaswamy Sankaranayananan [a], Maxwell Parkin [c]

[a] *Screening Group, International Agency for Cancer Research, 150 cours Albert Thomas, Lyon 69372, Lyon, France*
[b] *Instituto de Oncología Angel H. Roffo, Universidad de Buenos Aires, Buenos Aires, Argentina*
[c] *Cancer Research UK Centre for Epidemiology, Mathematics and Statistics, Wolfson Institute of Preventive Medicine, London, UK*

- 120 new diagnosis of cervical cancer
- 45% reduction of work hours
- 28% work interruption
- 39% loss of family income
- 37% reduction in daily amount of food consumed
- 43% delays in paying essential services
- 38% sale of property
- 28% children missed regularly school

Rubella infection in pregnancy

- Rubella vaccine safe & highly immunogenic
  - One dose >90% protection

- Rubella infection in pregnancy :
  - Miscarriage
  - Stillbirth
  - Congenital Rubella syndrome : deafness, heart disease, cataract

RESEARCH ARTICLE

Using Seroprevalence and Immunisation Coverage Data to Estimate the Global Burden of Congenital Rubella Syndrome, 1996-2010: A Systematic Review

Emilia Vynnycky[1,6]*, Elisabeth J. Adams[1,2,3], Felicity T. Cutts[6], Susan E. Reef[8], Ann Marie Navar[4,5], Emily Simons[7], Lay-Myint Yoshida[9], David W. J. Brown[1,11], Charlotte Jackson[6,10], Peter M. Strebel[7], Alya J. Dabbagh[7]

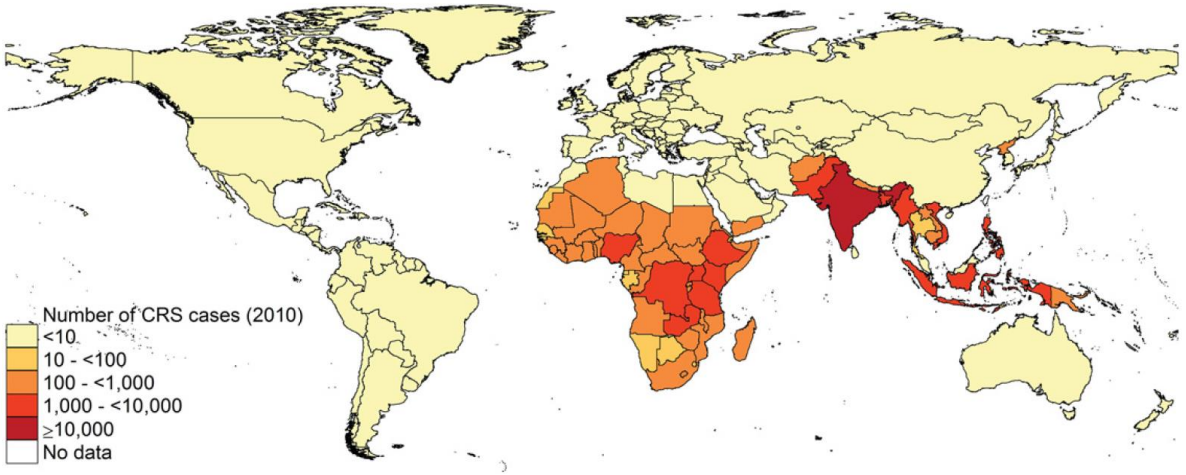


Fig 5. Estimates of the median numbers of CRS cases born by country in 2010.

Highest numbers of cases predicted in

- Africa (39,000, 95% CI: 18,000–80,000)
- SE Asia (49,000, 95% CI: 11,000–97,000).

In 2010, 105,000 (95% CI: 54,000–158,000) CRS cases were estimated globally, compared to 119,000 (95% CI: 72,000–169,000) in 1996.

OPEN ACCESS Freely available online

PLOS ONE

Exploring Risk Perception and Attitudes to Miscarriage and Congenital Anomaly in Rural Western Kenya

Stephanie Dellicour[1,2*], Meghna Desai[1,3], Linda Mason[2], Beatrice Odidi[1], George Aol[4], Penelope A. Phillips-Howard[2], Kayla F. Laserson[3,5], Feiko O. ter Kuile[2]

Stigma associated with miscarriages and congenital anomalies

A number of the causes given were associated with blame, either on the mother or her family, such as a woman's infidelity to her husband, or breaking a traditional taboo. This could lead to distrust between husband, mother-in-law and the wife/mother. Women reported that mothers are thus stigmatised rather than supported after going through the distress of having an adverse pregnancy outcome. Some reported that women who suffered from a miscarriage were ostracised and not allowed to come out of their home until they had been cleansed by a spiritual healer. Other pregnant women were also not able to come into contact with them as this might be passed on and cause them also to miscarry.

Neglect of children born with abnormalities was reported by a number of groups. Children with any congenital anomaly/disability were seen as not "useful" to the family and an extra burden, as well as stigmatized. This stigma might imply some taboo had been broken. Many respondents said such children are often hidden in homes or even killed. Only three women mentioned that they would love and provide the extra-care the child needed.

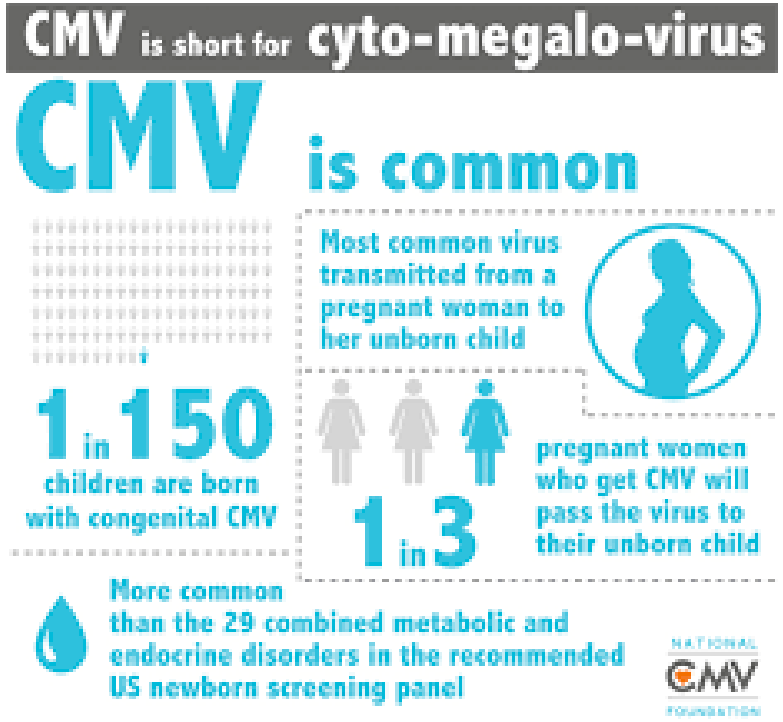
> "You would not love such kind of a child [with congenital anomaly]; I would not love the child because I would feel that he will not be of any help to me. And then taking care of him would be hard." (*FGD9, P5*)

> "I would love the child [born with a birth defect/disability] because he/she is mine; I'm the one who gave birth to her/him." (*FGD9, P1*)

> "Sometimes the grandmother speaks a lot and she might say that the child is not of her blood." (*FGD7, P7*)

Other potential vaccine-preventable cause of congenital malformation

Human Cytomegalovirus infection



Zika virus infection

Estimation of the costs of microcephaly (direct & indirect) : 3 billions -28.9 billions $

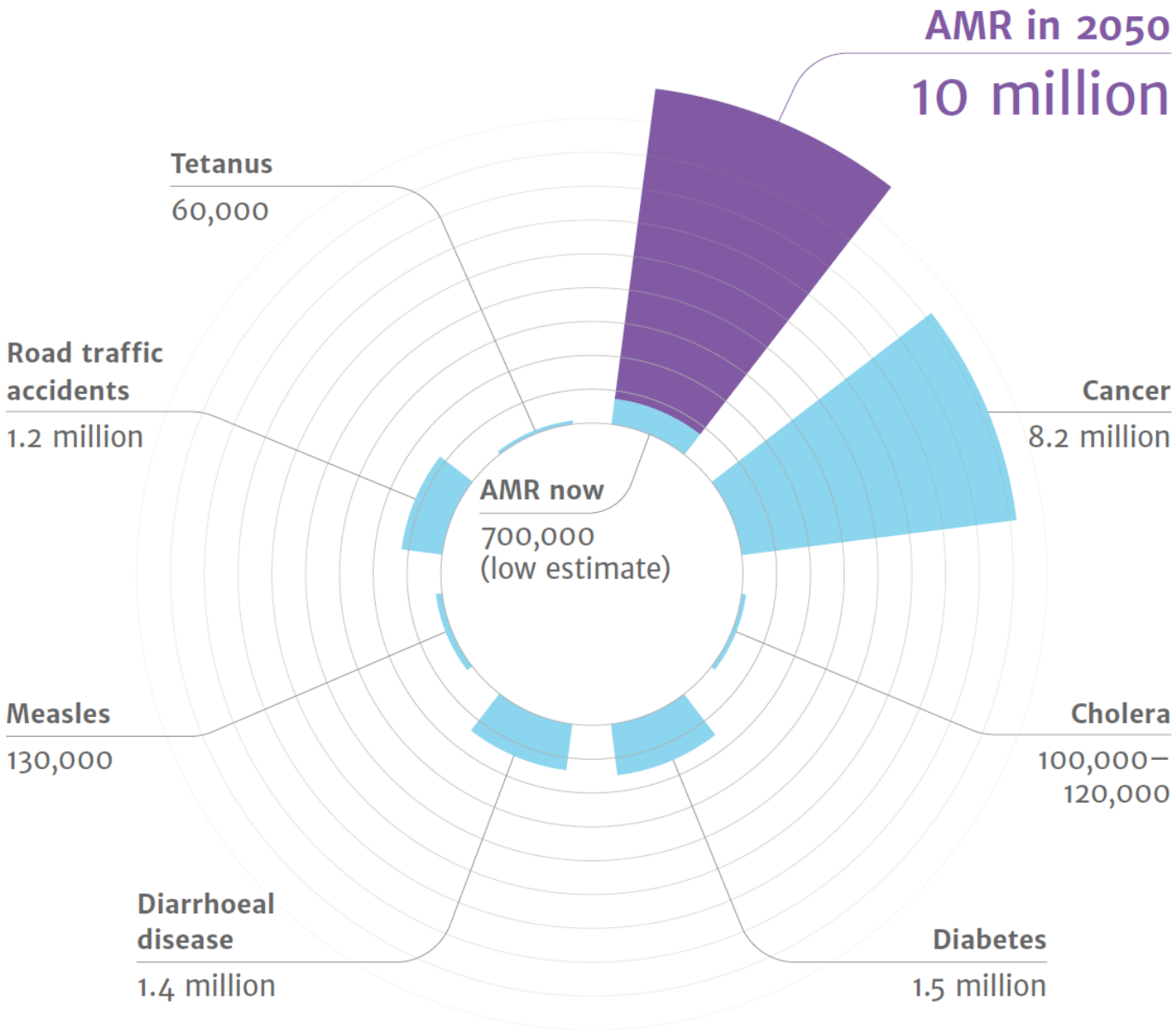
Congenital ZVI

- exacerbates poverty & inequities
- Increase gender inequality

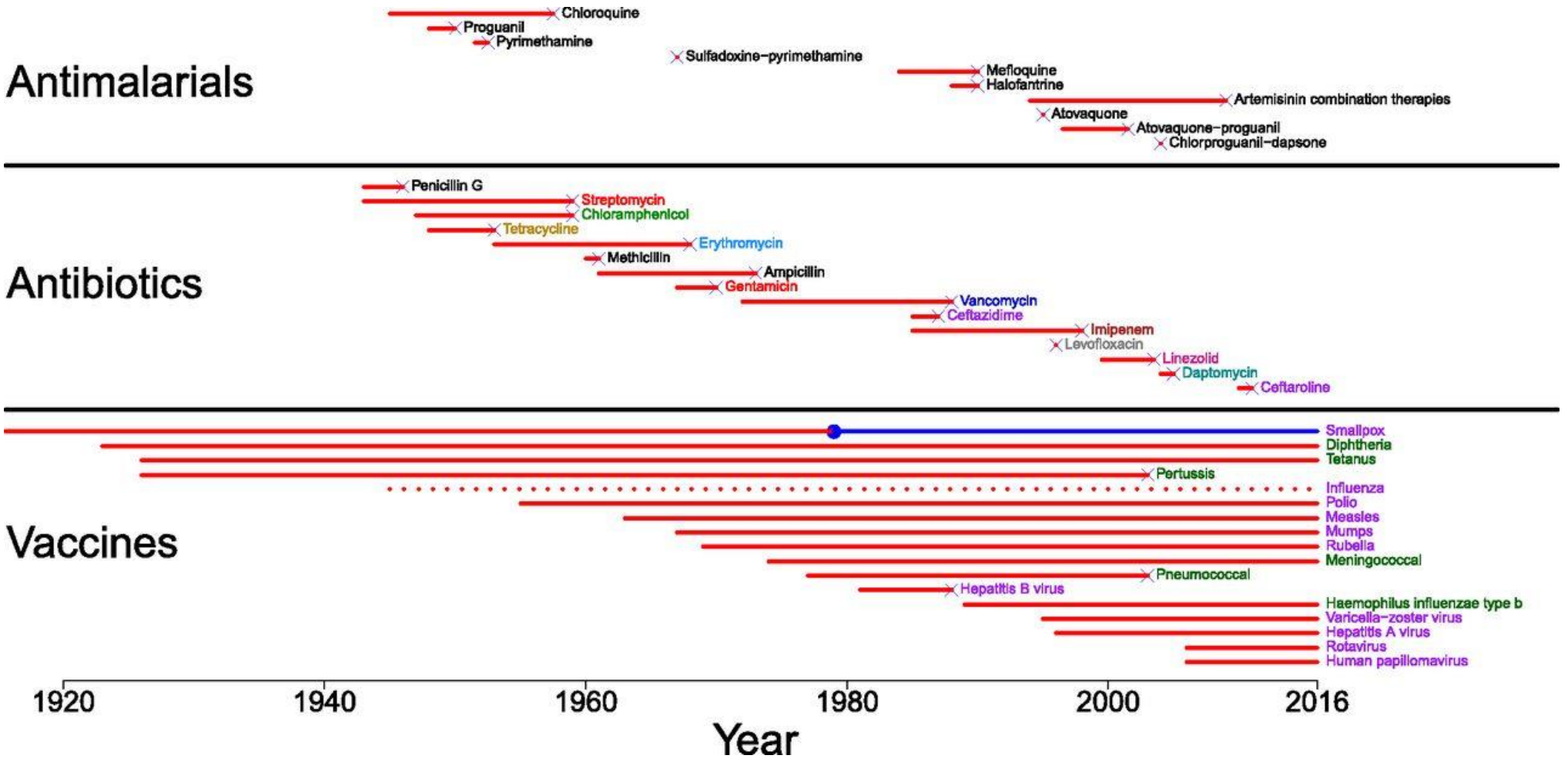
UNDP Report 2017

Societal impact of vaccines

1. Concepts : Narrow vs broad benefits of vaccination
2. Evidences from developping countries
3. Evidences from developped countries
4. Vaccination improves gender inequalities
5. **Vaccination & antimicrobial resistance**


AMR in 2050
10 million
Tetanus
60,000
Road traffic accidents
1.2 million
Cancer
8.2 million
AMR now
700,000
(low estimate)
Measles
130,000
Cholera
100,000–120,000
Diarrhoeal disease
1.4 million
Diabetes
1.5 million

Time between deployment of an intervention and the first documented failure in humans due to resistance (marked with “x”s).

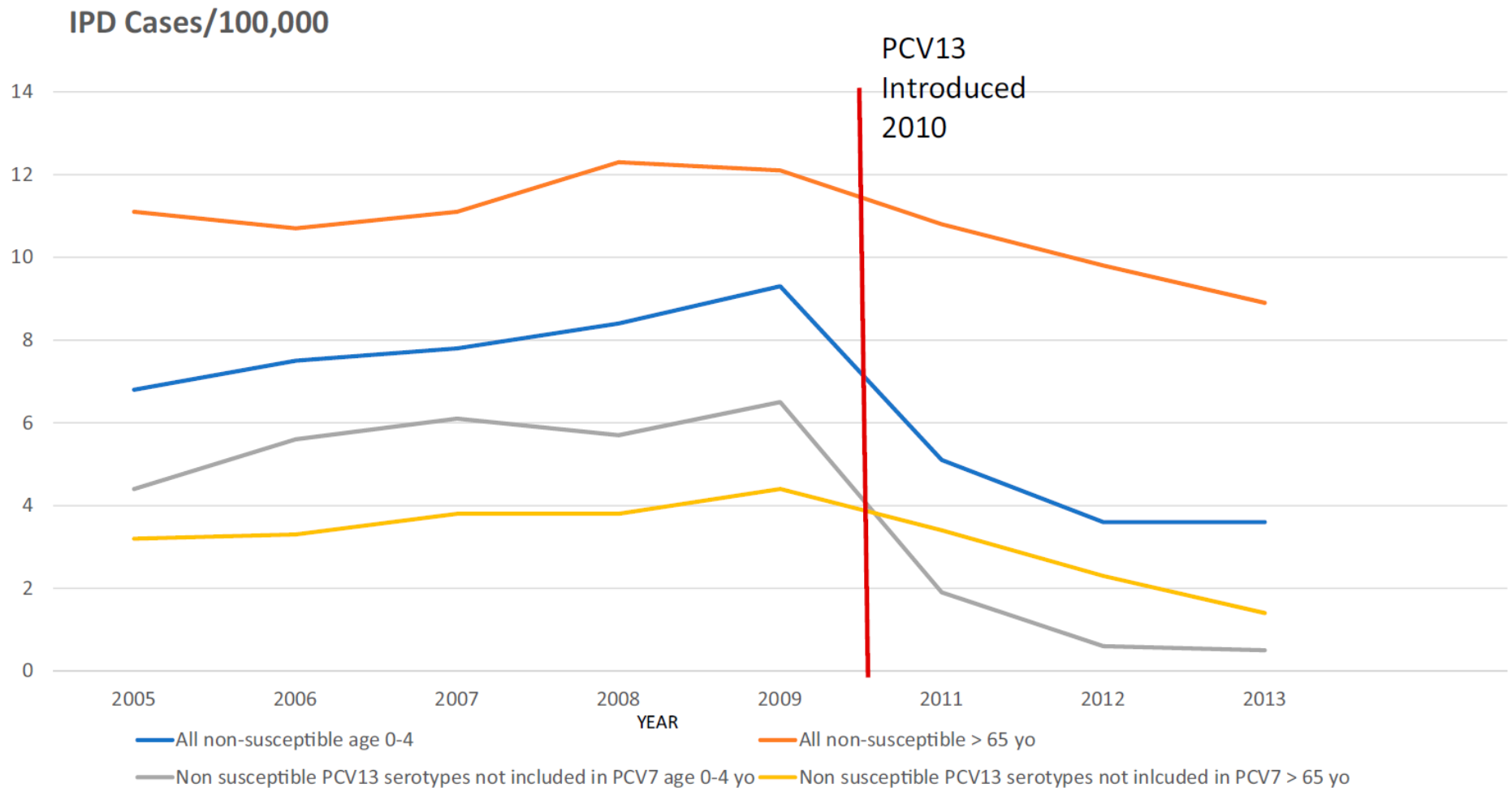


David A. Kennedy, and Andrew F. Read PNAS 2018;115:51:12878-12886

Mechanisms of vaccine impact on AMR

1) Reduce or eliminate the risk of infection due to antibiotic-resistant strains
2) Reduce antibiotic consumption associated with VPD
3) Decrease colonisation
4) Reduce the rate of febrile illness
    1) Prevent inapproriate use of antibiotic
    2) Decrease the risk of secondary infections

US trends in invasive non-penicillin susceptible pneumococcal disease 2005-2013

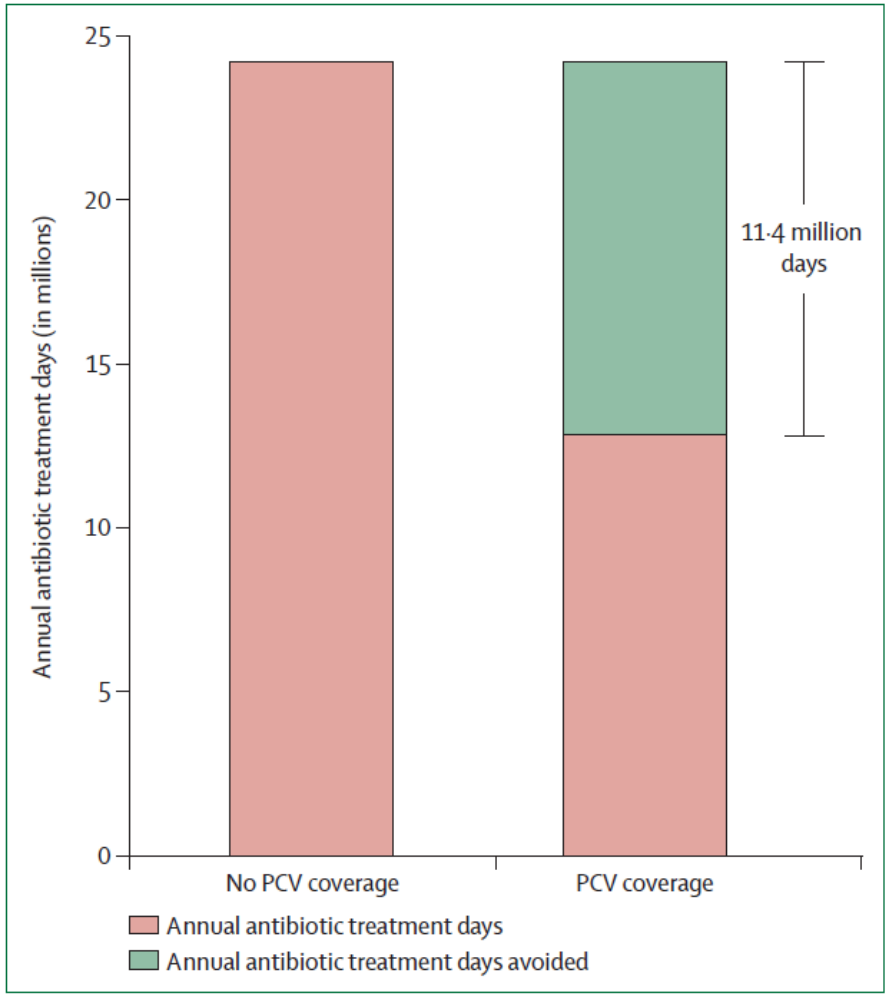


Klugman & Black *PNAS* 2018

Days on antibiotics for suspected pneumonia, averted by provision of pneumococcal conjugate vaccine (PCV)

Estimation based on universal PCV availability worldwide

47% reduction in the amount of antibiotics used for *S. pneumoniae* pneumonia (children < 5 years)



Laxminarayan *Lancet* 2015

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REUTERS

HEALTH NEWS

NOVEMBER 15, 2019 / 11:21 AM / 10 DAYS AGO

- **Pakistan deploys new vaccine against 'superbug' typhoid outbreak**
-

Kate Kelland

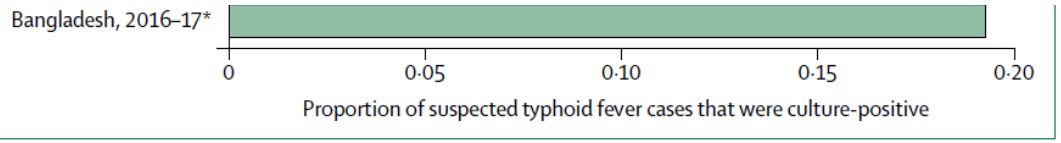
- Antimicrobials for suspected typhoid fever : >50 millions prescriptions/year

INTERNATIONAL
THE NEWS
(https://www.thenews.com.pk/)

Af

With 13,727 XDR typhoid cases reported, Sindh plans to reach 10.1m children

Karachi | M. Waqar Bhatti (https://www.thenews.com.pk/writer/m.-waqar-bhatti) | November 9, 2019



Influenza vaccine & antibiotic use

Turkey	Children	Decreased numbers of acute otitis media & otitis media with effusions in vaccine recipient
Italy	Children	13.2% fewer antibiotic prescriptions 6-mo 54.8% fewer otitis media episodes
Europe	RCT, 6-36 mo children Five seasons	50% fewer antibiotic prescription 47% fewer confirmed influenza infection
Canada	Population	64% fewer antibiotic prescription
UK	Children (LAIV)	14.5% fewer amoxicillin prescription during influenza season

Klugman & Black *PNAS* 2018

Other vaccine with potential to decrease antibiotic consumption

	Mechanisms		
Group B Strep	Maternal intra partum prophylaxis Neonatal sepsis	Phase III (GBS6)	
E. Coli neonatal sepsis	Direct AB consumption		
RSV	Pneumonia is frequent complication in both infants & elderly	Phase III (maternal & elderly)	
Dengue	Frequent administration of antibiotics in hospitalized children (50-60%)	Dengvaxia	

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Systematic review

Impact of vaccination on antibiotic usage: a systematic review and meta-analysis

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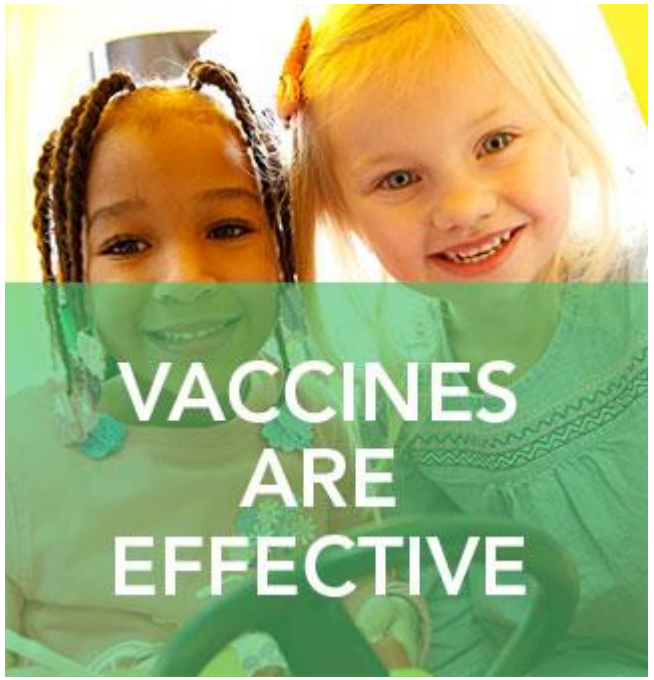
ABSTRACT

Background: Vaccines may reduce antibiotic use and the development of resistance.
Objectives: To provide a comprehensive, up-to-date assessment of the evidence base relating to the effect of vaccines on antibiotic use.
Data sources: Ovid MEDLINE, Embase, the Cochrane Library, ClinicalTrials.gov and WHO Trials Registry.
Study eligibility criteria: Randomized controlled trials (RCTs) and observational studies published from January 1998 to March 2018.
Participants: Any population.
Interventions: Vaccines versus placebo, no vaccine or another vaccine.
Methods: Titles, abstracts and full-texts were screened independently by two reviewers. Certainty of RCT evidence was assessed using GRADE.
Results: In all, 4980 records identified; 895 full-text reports assessed; 96 studies included (24 RCTs, 72 observational). There was high-certainty evidence that influenza vaccine reduces days of antibiotic use among healthy adults (one RCT; $n = 4253$; rate reduction 28·1%; 95% CI 16·0–38·4); moderate-certainty evidence that influenza vaccines probably reduce antibiotic use in children aged 6 months to 14 years (three RCTs; $n = 610$; ratio of means 0·62; 95% CI 0·54–0·70) and probably reduce community antibiotic use in children aged 3–15 years (one RCT; $n = 10\,985$ person-seasons; risk ratio 0·69, 95% CI 0·58–0·83); and moderate-certainty evidence that pneumococcal vaccination probably reduces antibiotic use in children aged 6 weeks to 6 years (two RCTs; $n = 47\,945$; rate ratio 0·93, 95% CI 0·87–0·99) and

Conclusions: The evidence base is poor. Although some vaccines may reduce antibiotic use, collection of high-quality data in future vaccine trials is needed to improve the evidence base.

Conclusions

- Vaccination is one of the most cost-effective health intervention
- Vaccination is a long-life Investment and has impact on generations
  - Education
  - Labour force
  - Macro economics parameters
- Vaccination prevents costly outbreaks
- Vaccination is a tool to limit gender inequalities
- Vaccination contributes to limit the health & economical impact of AMR
  - Decreasing the risk of infection with resistant pathogen
  - Indirectly by decreasing antibiotic consumption



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